PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Masato KANEDA, et al.

Appln. No.: 10/582,787

Confirmation No.: 5976

Filed: June 13, 2006

For: PHOTOSENSITIVE COMPOSITION REMOVER

Docket No: Q79148

Group Art Unit: 1795

Examiner: Anca EOFF

DECLARATION UNDER 37 C.F.R. § 1.132

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Kouichi Terao, hereby declare and state:

THAT I am a citizen of Japan;

THAT I graduated from the Applied Chemistry Department, Faculty of Engineering, Niigata University in March, 1988;

THAT I finished the Master's Program of Applied Chemistry, the Graduate School of Science and Technology, Niigata University, in March, 1990;

THAT I have been employed by Showa Denko K.K. since April, 1990, where I was engaged in a project for manufacturing acrylamide and development of a new acrylic resin in the Kawasaki plant;

THAT I moved to the Higashinagahara Plant in March, 1993, where I was engaged in research of a method for producing a herbicide;

THAT I moved to the Tokuyama Plant in March, 1998, where I was engaged in development of special reagents such as reagents for analyzing low water content, dioxin and the like;

THAT since March, 2004, I have been engaged in development of a photosensitive composition remover used in a process for manufacturing a color filter in the Tokuyama Plant; and

THAT in order to demonstrate the unexpected superiority of the present invention, the following experimentation was conducted by me or under my direct supervision.

EXPERIMENTATION

EXPERIMENT 1

Firstly, a composition similar to Example 4 of Wyatt et al. (US 2003/0118946 AI) was studied. Preparation of the following two solvent mixtures was tried.

Solvent mixture (a): 20 percent by weight of SW 1500 (a basically C_{10} aromatic hydrocarbon-based mixed solvent), 20 percent by weight of benzyl alcohol, and 60 percent by weight of isoparaffinic hydrocarbon (Solfine® C-550)

Solvent mixture (b): 20 percent by weight of diisopropylbenzene (a C_{12} aromatic hydrocarbon), 20 percent by weight of benzyl alcohol, and 60 percent by weight of isoparaffinic hydrocarbon (Solfine® C-550)

Results of Experiment 1

Solvent mixtures (a) and (b) both separated into two phases when they were prepared. Therefore, cleanability of Solvent mixtures (a) and (b) was not able to be evaluated.

EXPERIMENT 2

Secondly, the following three solvent mixtures were prepared, and cleanability for photosensitive compositions (resist materials) containing a red, green or blue pigment was evaluated.

Solvent mixture (1): 20 percent by weight of Swasol 1500 (a basically C_{10} aromatic hydrocarbon-based mixed solvent, from Maruzen Petrochemical Co., Ltd.), 20 percent by weight of butanol, and 60 percent by weight of propylene glycol monomethyl ether acetate

Solvent mixture (2): 20 percent by weight of diisopropylbenzene (a C_{12} aromatic hydrocarbon), 20 percent by weight of butanol, and 60 percent by weight of propylene glycol monomethyl ether acetate

Solvent mixture (3): 10 percent by weight of Solfine®-TM (a basically C_9 aromatic hydrocarbon-based mixed solvent, from Showa Denko K.K.), 10 percent by weight of SW 1500 (a basically C_{10} aromatic hydrocarbon-based mixed solvent), 20 percent by weight of propylene glycol monomethyl ether, and 60 percent by weight of cyclohexanone

Results of Experiment 2

The obtained results of cleanability are shown in paragraph 4 of Appendix 1.

Solvent mixture (3), which falls within the scope of claim 3 of the present application, was remarkably excellent in cleanability. Although the difference between Solvent mixture (1) and Solvent mixture (2) was small, the remaining amount of pigment showed that Solvent mixture (1) containing C_{10} aromatic hydrocarbons had higher cleanability than Solvent mixture (2) containing C_{12} aromatic hydrocarbons.

However, a carbon number difference in cleanability was small, perhaps because choice of components other than aromatic hydrocarbons was not proper. Instead, the obtained results showed that a solvent mixture containing no alcohol is superior in cleanability to a solvent mixture containing an alcohol.

EXPERIMENT 3

In the light of the above results, the following three solvent mixtures containing no alcohol were prepared, and cleanability for photosensitive compositions (resist materials) containing a red, green, blue or black pigment was evaluated.

Solvent mixture (4): 50 percent by weight of Solfine®-TM (a basically C_9 aromatic hydrocarbon-based mixed solvent), and 50 percent by weight of propylene glycol monomethyl ether.

Solvent mixture (5): 50 percent by weight of diisopropylbenzene (a C_{12} aromatic hydrocarbon), and 50 percent by weight of propylene glycol monomethyl ether.

Solvent mixture (3): 10 percent by weight of Solfine®-TM (a basically C_9 aromatic hydrocarbon-based mixed solvent), 10 percent by weight of SW 1500 (a basically C_{10} aromatic hydrocarbon-based mixed solvent), 20 percent by weight of propylene glycol monomethyl ether, and 60 percent by weight of cyclohexanone (this solvent mixture was the same as Solvent mixture (3) of Experiment 2)

Results of Experiment 3

The obtained results of cleanability are shown in paragraph 4 of Appendix 2.

It was found that Solvent mixture (4) containing Solfine®-TM (a basically C_9 aromatic hydrocarbon-based mixed solvent) was superior in cleanability to Solvent mixture (5) containing diisopropylbenzene (a C_{12} aromatic hydrocarbon) because the remaining amount of pigment in Solvent mixture (4) was smaller than in Solvent mixture (5). Therefore, it has been confirmed that cleanability varies with the carbon number of the aromatic hydrocarbon that is used.

Although a basically C_9 aromatic hydrocarbon-based mixed solvent Solfine®-TM was used in Solvent mixture (4), aromatic hydrocarbons having 10 carbon atoms have approximately the same cleanability as aromatic hydrocarbons having 9 carbon atoms.

For reference, Solvent mixture (3), which falls within the scope of claim 3 of the present application, was also evaluated for cleanability, and good results were obtained. The results show that Solvent mixture (3) has higher cleanability for a photosensitive composition (a resist material) containing a black pigment than Solvent mixture (4).

CONCLUSION

In view of the above and Appendix 1 and Appendix 2, I conclude that the present invention provides unexpectedly superior results.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States

Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: Feb. 10, 2010

By: Kouichi Terao
Kouichi Terao

APPENDIX 1

EXPERIMENT 2

1. Purpose

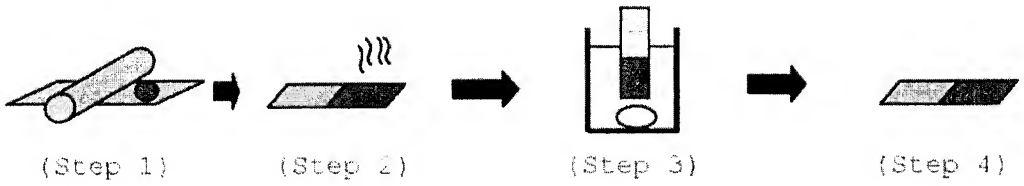
This experiment was to compare solvent mixtures' capacity to clean off a pigment-containing photosensitive composition, specifically to show difference in cleanability between a solvent mixture containing a C_9 or C_{10} aromatic hydrocarbon and a solvent mixture containing a C_{12} aromatic hydrocarbon.

2. Method

This experiment was performed in a manner similar to the method described in Example 1 on page 23 of the description of the present application.

Three pigment-containing photosensitive compositions were used. The first one contained a red pigment. The second one contained a green pigment. The third one contained a blue pigment.

The method comprised the following four steps.



Step 1: Applying a pigment-containing photosensitive composition on a half surface of a substrate by a bar coater.

Step 2: Prebaking the applied substrate at 100°C for 1 minute.

Step 3: Immersing the applied part of the substrate in a solvent mixture with stirring for 1 minute.

Step 4: Drying.

3. Solvent Mixtures

Three solvent mixtures were prepared in the following mixing ratios in percent by weight.

	Aromatics			BuOH	PGMMEA	PGMME	CYA
	3MB	4MB	DIPB				
Solvent mixture (1)		20		20	60		
Solvent mixture (2)			20	20	60		
Solvent mixture (3)	10	10				20	60

where

3MB: trimethylbenzene (Solfine®-TM, from Showa Denko K.K.)

4MB: tetramethylbenzene (Swasol 1500, from Maruzen Petrochemical Co., Ltd.)

DIPB: diisopropylbenzene

BuOH: butanol

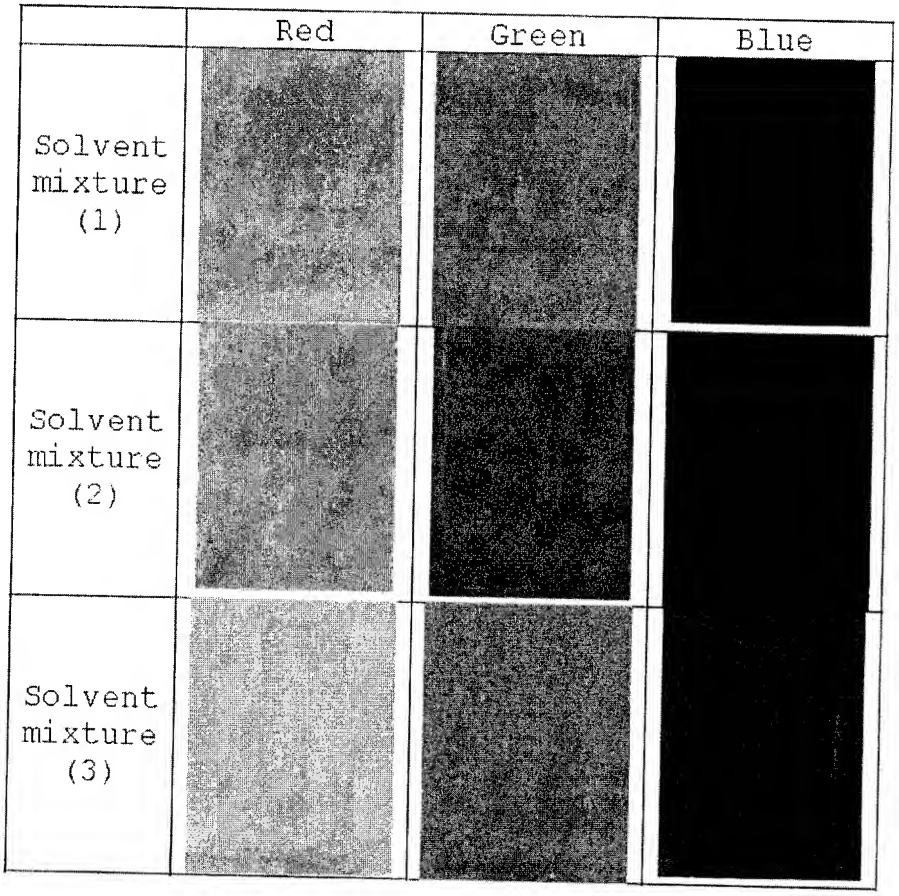
PGMMEA: propylene glycol monomethyl ether acetate

PGMME: propylene glycol monomethyl ether

CYA: cyclohexanone

4. Results

Photographs of the substrate surfaces after step 4 are shown in the following table.



The results show that Solvent mixture (1) containing C_{10} aromatic hydrocarbons has higher cleanability than Solvent mixture (2) containing C_{12} aromatic hydrocarbons.

The results also show that a solvent mixture containing propylene glycol monomethyl ether and cyclohexanone has higher cleanability than a solvent mixture containing an alcohol.

APPENDIX 2

EXPERIMENT 3

1. Purpose

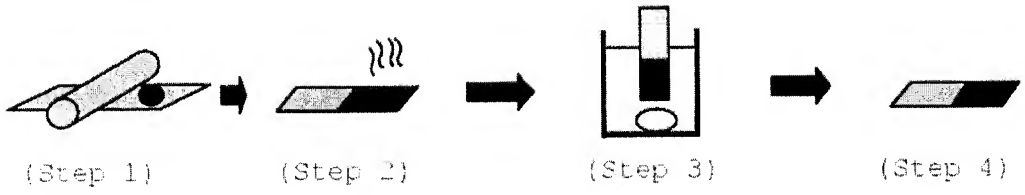
This experiment was to compare solvent mixtures' capacity to clean off a pigment-containing photosensitive composition, specifically to show difference in cleanability between a solvent mixture containing a C_9 or C_{10} aromatic hydrocarbon and a solvent mixture containing a C_{12} aromatic hydrocarbon.

2. Method

This experiment was performed in a manner similar to the method described in Example 1 on page 23 of the description of the present application.

Four pigment-containing photosensitive compositions were used. The first one contained a red pigment. The second one contained a green pigment. The third one contained a blue pigment. The fourth one contained a black pigment.

The method comprised the following four steps.



Step 1: Applying a pigment-containing photosensitive composition on a half surface of a substrate by a bar coater.

Step 2: Prebaking the applied substrate at 100°C for 1 minute for photosensitive compositions containing a red, green or blue pigment and at room temperature for 5 minutes for photosensitive compositions containing a black pigment.

Step 3: Immersing the applied part of the substrate in a solvent mixture with stirring for 1 minute.

Step 4: Drying.

3. Solvent Mixtures

Three solvent mixtures were prepared in the following mixing ratios in percent by weight.

	Aromatics			PGMME	CYA
	3MB	4MB	DIPB		
Solvent mixture (4)	50			50	
Solvent mixture (5)			50	50	
Solvent mixture (3)	10	10		20	60

where

3MB: trimethylbenzene (Solfine®-TM, from Showa Denko K.K.)

4MB: tetramethylbenzene (Swasol 1500, from Maruzen Petrochemical Co., Ltd.)

DIPB: diisopropylbenzene

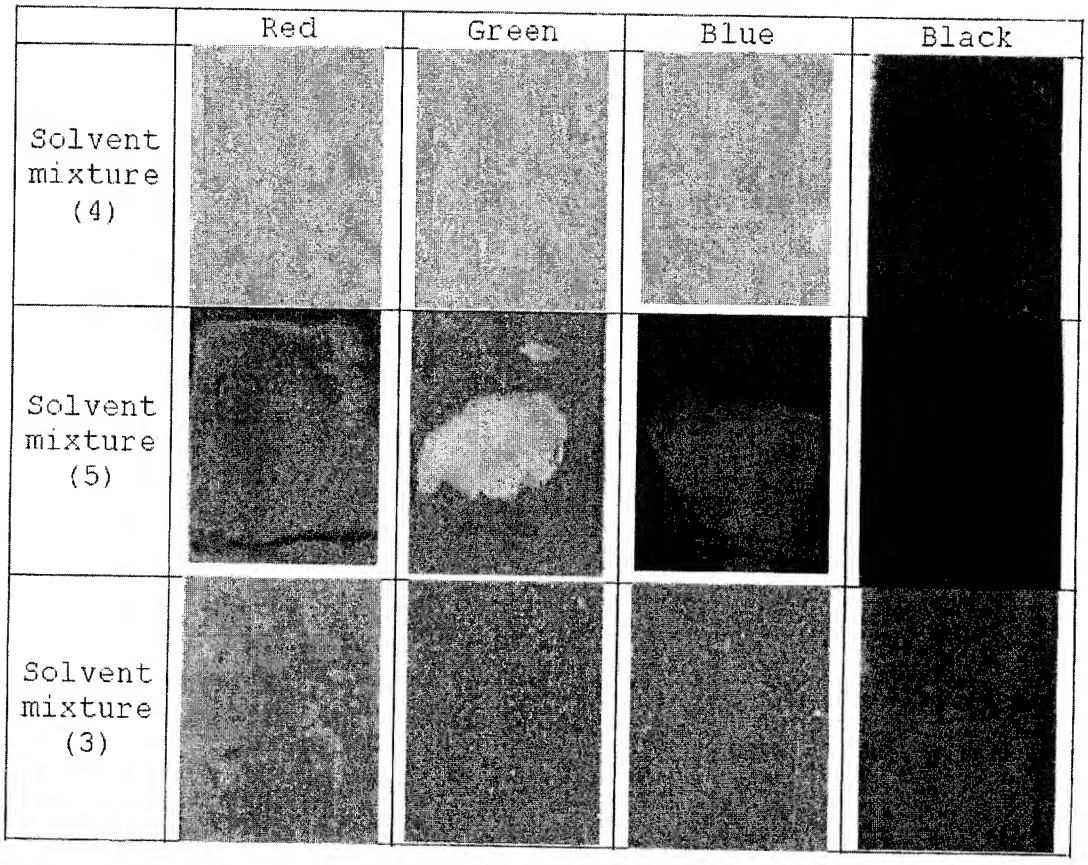
PGMME: propylene glycol monomethyl ether

CYA: cyclohexanone

Solvent mixture (3) was the same as Solvent mixture (3) prepared in Experiment 2.

4. Results

Photographs of the substrate surfaces after step 4 are shown in the following table.



The results show that Solvent mixture (4) containing C_{10} aromatic hydrocarbons has higher cleanability than Solvent mixture (5) containing C_{12} aromatic hydrocarbons.

The results also show that addition of cyclohexanone as the third component to a solvent mixture resulted in high cleanability also for a photosensitive composition containing a black pigment.